HARRISON H. BARRETT
2000 MEDICAL IMAGING SCIENTIST AWARD

At last year's IEEE Medical Imaging Conference in Lyon, France, Harrison H. Barrett, Ph.D., was presented with the prestigious IEEE Medical Imaging Scientist Award in recognition of his outstanding contributions to the field. Presented in alternate years, this award honors an individual for significant innovations, research contributions, and influence on medical imaging science through education.

Dr. Barrett, who is Regents Professor of Radiology, Optical Sciences, and Applied Mathematics at the University of Arizona, was cited for substantial research accomplishments in the physics, mathematics, and engineering aspects of medical imaging science. In addition, he was recognized for a history of outstanding mentorship and leadership contributions. He was nominated by an impressive roster of 32 collaborators, including many former students who have become highly prominent scientists in their own right.

Dr. Barrett has been a creative innovator of the theory and technology of imaging science for over 30 years. His research results are significant, extensive, and fundamental (he has over 250 publications and over 20 patents); the impact of his research has been immediate and lasting.

Dr. Barrett received the Ph.D. in Applied Physics from Harvard University in 1969. In 1971, he accepted a position as a Project Leader in the Medical Electronics Unit of the Research Division of Raytheon Corporation. This move initiated his research efforts in medical imaging science which have continued for 30 years (and counting). In 1974, he moved to the University of Arizona as an Associate Professor in the Optical Sciences Center and the Department of Radiology, and two years later was promoted to full Professor. In 1990, Dr. Barrett was honored by the University of Arizona with the title of Regents Professor.

In 1972, Dr. Barrett published "Fresnel zone plate imaging in nuclear medicine", which reported some of the first results of the use of coded apertures in nuclear medicine and included the first use of the term "coded" to describe an aperture that multiplexes images. From 1971 to 1985, Dr. Barrett authored or co-authored over 50 publications on the foundations of tomographic imaging. Some were analysis of coded aperture systems; others of more conventional systems.

From 1982 to 1995, the development of high-resolution, high-sensitivity nuclear medicine systems for dynamic 2D and 3D multiple-pinhole coded- and non-coded aperture imaging served as a framework for many of Dr. Barrett's investigations. In 1984, Dr. Barrett proposed the development of modular scintillation cameras as a means of increasing system sensitivity through the increasing of system count rate. The development of modular cameras involved the development and implementation of schemes for maximum-likelihood position estimation and was followed by the development of several multiple-pinhole coded-aperture modular-camera systems, including a system known as FASTSPECT.

The degree of mathematics and physics rigor found in Dr. Barrett's research sets his results apart from those of most other investigators in medical imaging science. This is particularly true of his work to develop methods for objective assessment of image quality. His results include development of analytic model observers and significant use of psychophysical studies with human observers. Analysis of models of lumpy backgrounds contributed significantly to the designs of a variety of counting and imaging probes he and his collaborators built, including dual-detector, esophageal, and collimatorless coincidence probes.

Forward problems, inverse problems, and tomographic reconstruction are pervasive in medical imaging. Dr. Barrett has investigated extensively the noise properties of maximum-likelihood expectation-maximization reconstruction, has developed novel approaches to list-mode likelihood reconstruction, and extensively characterized discrete-data cone-beam tomography.

Dr. Barrett and collaborators are significant contributors to the development of semiconductor arrays for high-resolution gamma-ray imaging, the analysis and use of the pixel information and signal-processing properties of semiconductor sensors, and the use of such sensors in ultra-high resolution planar and tomographic small-animal imagers. This work is the practical implementation of theoretical analysis that demonstrates that a key to optimal system design is maximization of space-bandwidth product.

Professor Barrett has, for over 30 years, been a dedicated, successful educator and mentor. He has been the primary advisor of more than 15 M.S. and 45 Ph.D. students; the impact of that effort alone is extensive. His oral and written expositions are superb; volumes one and two of *Radiological Imaging: Theory of Image Formation, Detection, and Processing*, which he co-authored with William Swindell, are evidence of this. His writing has been appreciated by hundreds, probably thousands, of medical imaging science students and researchers throughout the world.

Dr. Barrett is a Fellow of the American Physical Society, the Optical Society of America, and the American Institute of Medical and Biological Engineering.

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